Layer 1 Cooperative Power Management in Dual PSE Systems

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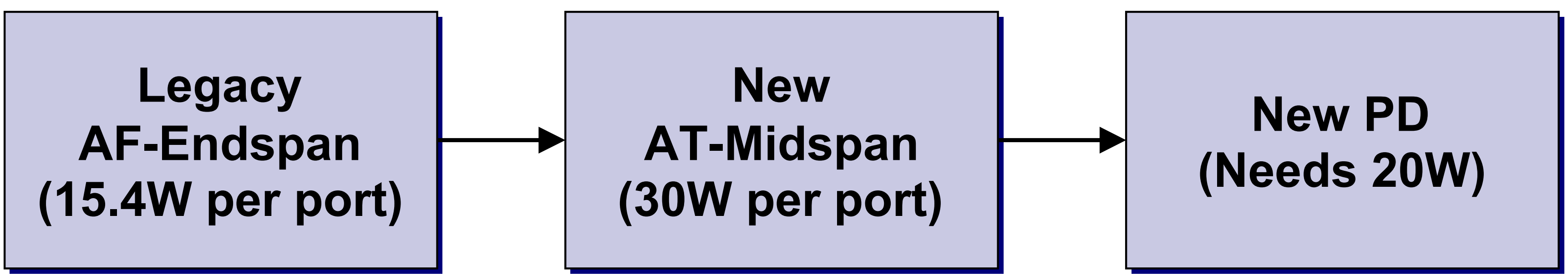
A Very Common Scenario

- Suppose a customer wants to use a new PD that requires 20W.
- Their old AF-endspan obviously can't power this PD, so they buy a new AT-midspan.
- The setup looks good, right?



Unfortunately it Doesn't Work

- For this setup to work, the AT-midspan must power the PD, since the AF-endspan can't.
- But the endspan will usually (maybe always) power the PD.
  - Midspans have a detection back-off period but endspans don't.
  - No guarantee the endspan will ever power the PD.
- Therefore, this setup won't work with the detection protocol as presently defined in 802.3af.

What We Want to Happen

- The system should be *plug-and-play*. If there is a PSE in the setup that's capable of powering the PD, then the PD should always get power.
- The system should automatically utilize *both* PSE in some organized deterministic way.
  - All the low-power PDs go to the AF-PSE, until it runs out of power budget.
  - All the medium-power PDs go to the AT-PSE.
  - Any low-power PDs that are rejected by the AF-PSE get picked up by the AT-PSE.

A Possible Solution

- Layer 1 Cooperative Power Management:
  - AT-PSE must always be the first to detect the PD.
  - AT-PSE performs initial classification:
    - If the PD requests >15.4W then the AT-PSE powers it.
    - Otherwise the AT-PSE allows the AF-PSE to attempt to detect, classify, and power the PD.
  - If the AF-PSE rejects the PD (or there is no AF-PSE present in the system) then the AT-PSE powers it.
- But this requires the AT-PSE to have the ability to inhibit the AF-PSE detection process.

Endspan Detection Inhibitor

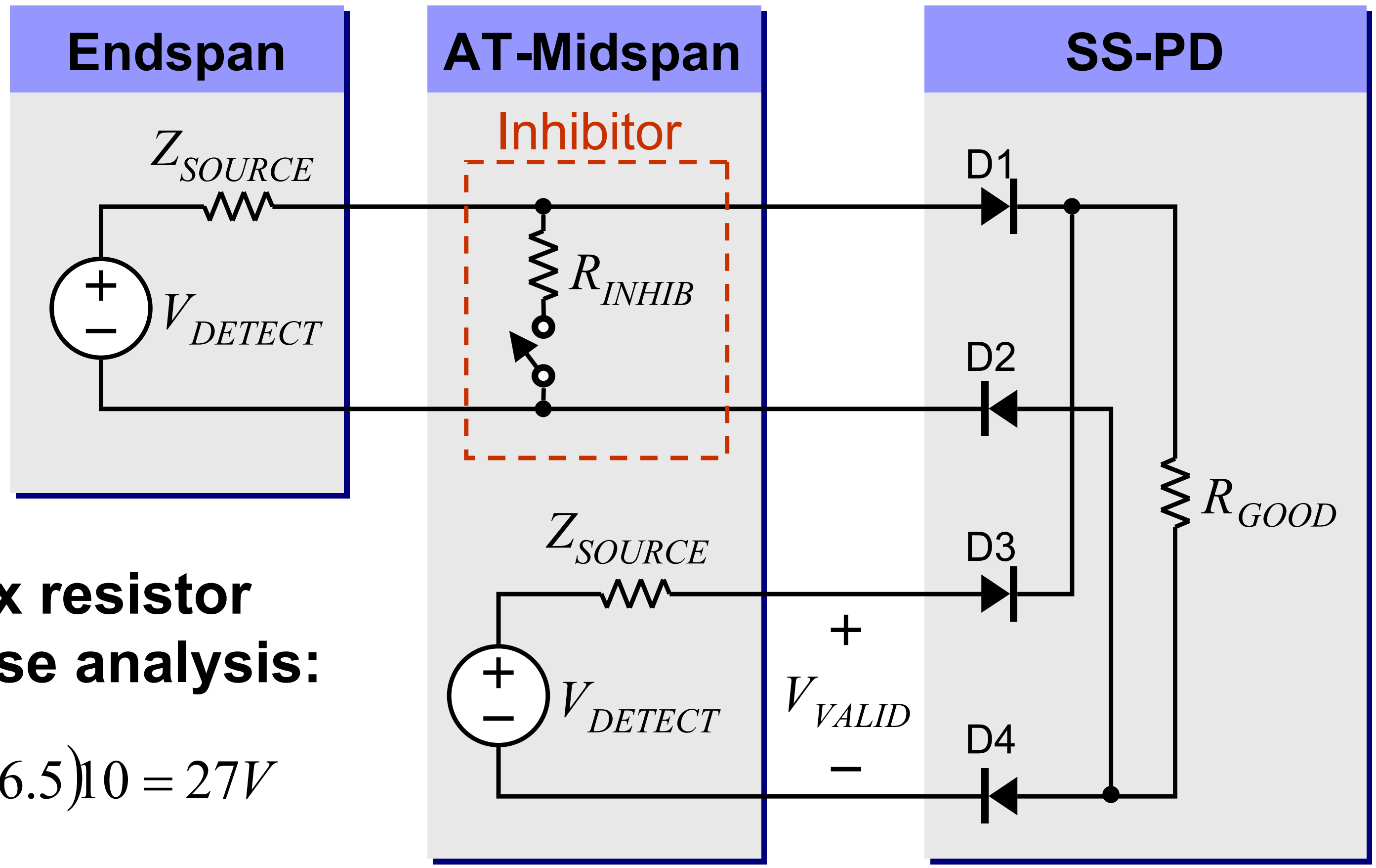
From 802.3af:

$$Z_{SOURCE} \geq 45k$$

$$10V \geq V_{VALID} \geq 2.8V$$

$$26.5k \geq R_{GOOD} \geq 19k$$

$$30V \geq V_{DETECT}\ \text{(OC)}$$



Calculation of max resistor value by worst-case analysis:

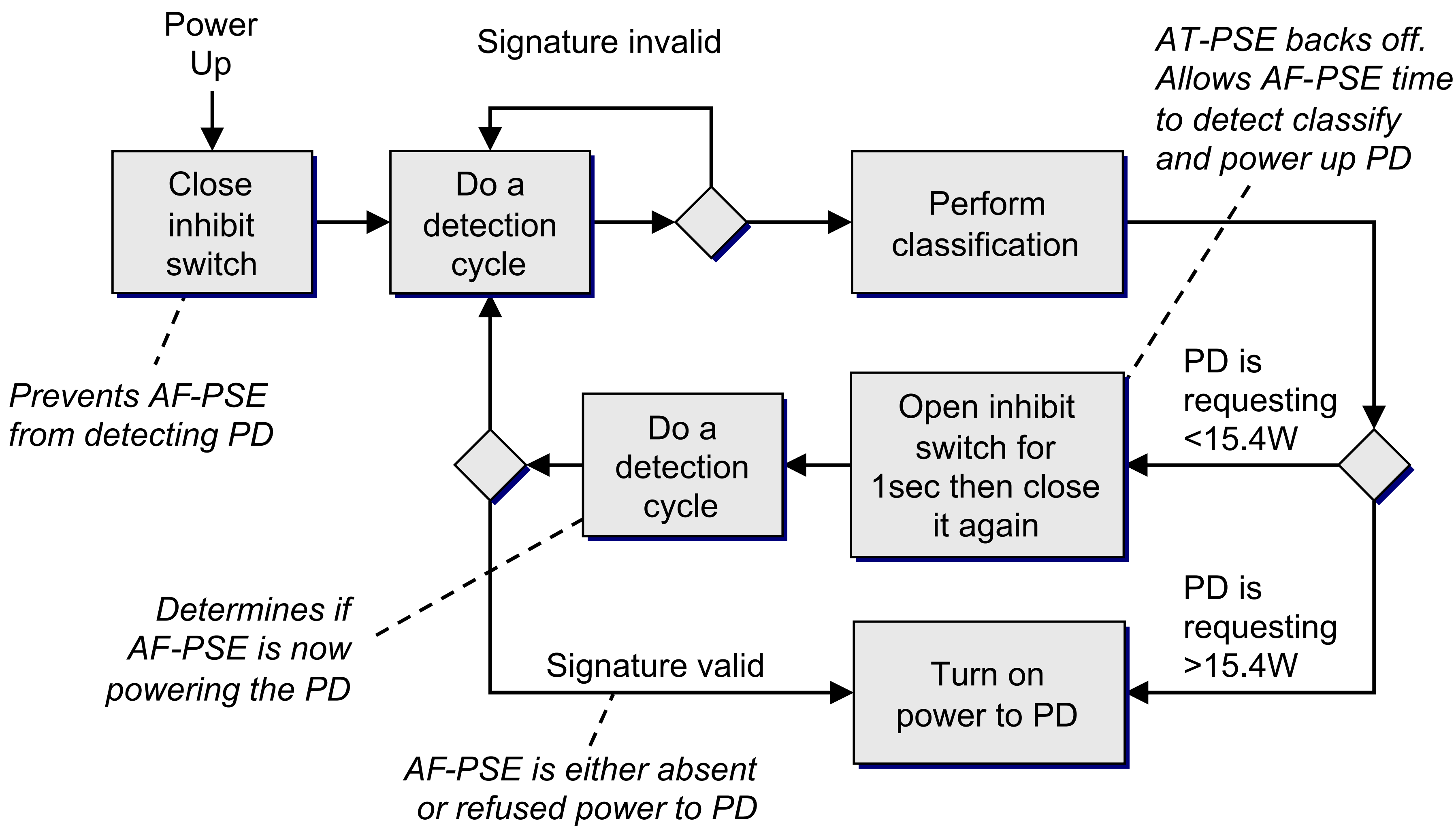
$$V_{DETECT} \leq (1 + 45/26.5)10 = 27V$$

$$R_{INHIB} \leq \frac{45k}{(27/2.8)-1} = 5.2k$$

How Does it Work?

- When the switch is closed, it does two things:
  - Allows the midspan to detect without interference.
    - R_{INHIB} pulls endspan voltage below 2.8V.
    - Midspan voltage > 2.8V while it attempts detection.
    - Therefore D1 and D2 are reverse biased, temporarily removing the endspan from the circuit.
  - Presents invalid detection signature to the endspan.
- The midspan controls the process according to the flow chart shown on the next slide.
  - Key points are the 1 second back-off *after* classification, and the extra detection that follows it.

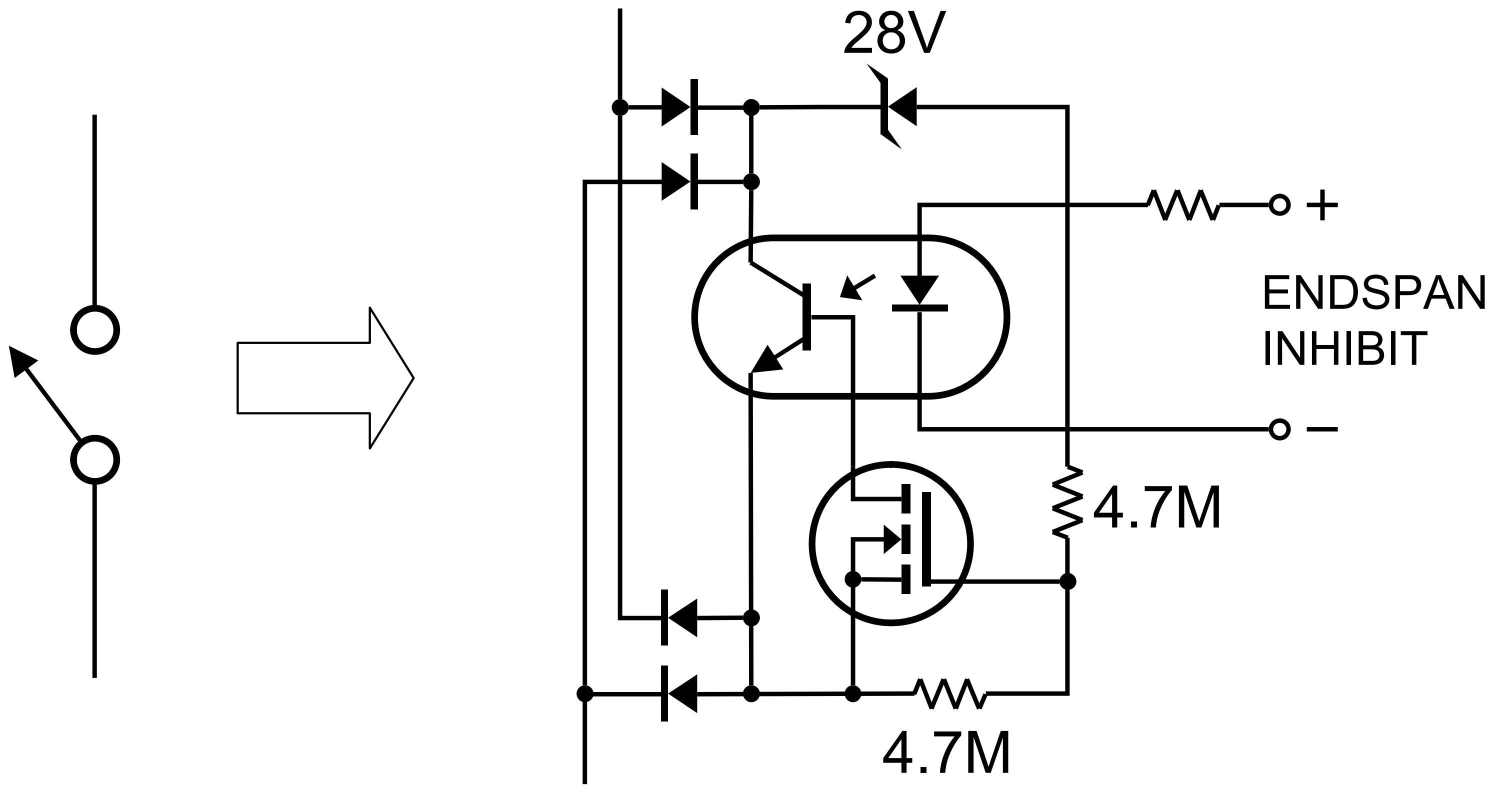
AT-PSE Protocol (Simplified)



Switch Requirements

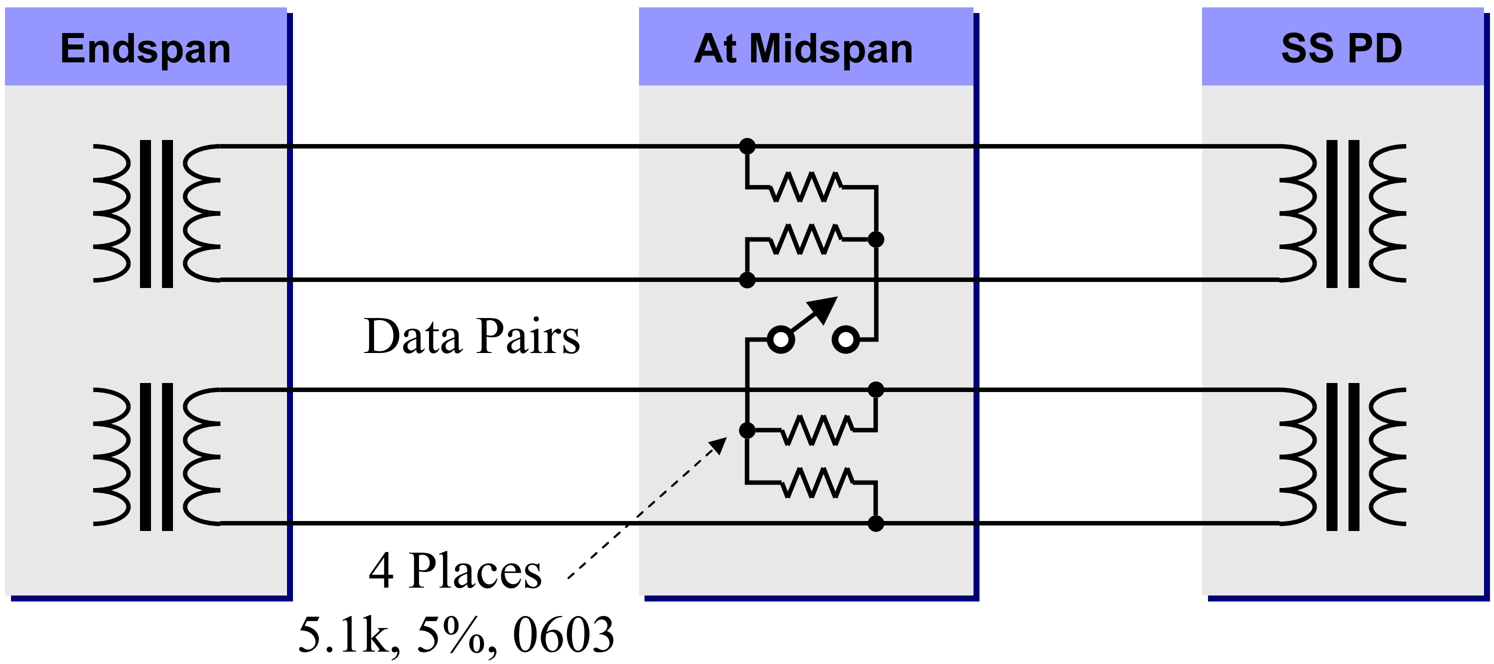
- Overvoltage lockout. Switch must not close while endspan powers PD.
  - Avoids current pulses that could look like DC_MPS.
  - Avoids overheating resistors.
- R_{OFF} >> Z_{AC2} to avoid AC_MPS problems.
- Isolation from chassis and other port circuits.
- Works independent of voltage polarity.
- Low cost.
- Does not require a power supply

A Possible Switch Circuit



Will it Affect Data Integrity?

- No. If laid out properly reflections will be negligible.
  - 10.2k (line-to-line within each pair) >> 100 Ohm characteristic impedance of CAT-5 cable.
  - Small resistors can to be placed directly on traces to avoid stubs.



Summary

- The scenario where AT-midspan and AF-endspan coexist will be common. This presents a challenge:
  - For medium power PDs this setup won't work because the AF-endspan detects the PD before the AT-midspan.
  - Therefore we need an improved power management scheme that allows midspan and endspan to work together.
- A simple L1 cooperative power management protocol was presented to fix the problem.
  - A simple circuit allows the midspan to inhibit the endspan without affecting data integrity.
  - The same circuit also allows the midspan to determine if the endspan is powering the PD.